Claim 26. (New) The article according to Claim 24, wherein said microstructure or nanostructure recesses are used as a microanalysis unit.

Claim 27. (New) The article according to Claim 22, characterized in that said recesses are not pinched or plugged as a result of said bonding.

Claim 28. (New) The article according to Claim 22, wherein said two work pieces are made of the same material.

Claim 29. (New) The article according to Claim 22, wherein at least one of said work pieces is made of one of the group consisting of PMMA, polycarbonate and polymethacryl.

REMARKS

Claim 6 has been amended, claims 2-5 and 7-11 have been canceled, and claims 12 – 29 are newly added. Claims 1, 6 and 12-29 are currently pending in the application.

In the amended claim 6, the claim dependency has been set forth in proper format.

The newly added claims generally track the form and intent of the original claim set but are now provided in a more common claim format. Basis for the newly added claims are provided in the table below:

Claim	Term/Phrase	Basis
12-22	hot-melt adhesion method	Specification, p. 8, lines 6-9.
12, 21	each work piece having an intended contact surface by which the two work pieces bond; …subjecting at least in some sections of the intended contact surface of at least one of th work pieces to a high-energy radiation…; …causes a lowering of a glass transition temperature…in a marginal layer to produce a modified marginal layer; contacting the intended contact surfaces of the two work pieces; heating at least the the modified marginal	Claim 1 (original).

	layer to a temperature above the glass transition temperature but below that of the unmodified areas…;	
13	entirety of said intended contact surface…subjected to high-energy radiation	Claim 2 (original).
14	at least some sections of both of said intended contact surfaces are subjected to high-energy radiation	Claim 5 (original).
15	UV, laser, X ray and synchrotron radiation	Specification, p. 3, lines 3-4.
16	both of said work pieces are heated	Claim 4 (original); Specification, p. 3, lines 21-22.
17, 21, 22	intended contact surface contains microstructure or nanostructure recesses	Claim 7 (original). "microstructure" or "nanostructure" are collectively "recesses", see e.g. Specification, p. 5, lines 1-2.
17, 24	modified marginal layer is a fraction of a um	Specification, p. 3, lines 7-8.
17, 24	recesses remain dimensionally stable	Specification, p. 7, lines 14-17.
18, 27	recesses are not pinched or plugged	Specification, p. 3, lines 26-27. Specification, p. 7, lines 14-17.
19	work pieces are continuous films	Specification, p. 4, lines 2-5.
20, 21	holding said work pieces under pressure in relation to each other	Claim 3 (original); Specification, p. 3, line 29.
21, 23	electrodes are provided on said contact surface	Claim 8 (original).
22	each having a contact surface by which the two work pieces are…bonded; modified marginal layer is produced by high energy radiation in at least a section of at least one of the contact surfaces; such that the modified marginal layer is characterized by a glass transition temperature lower than that of unmodified	Claim 1 (original).

	areas…	
25	recesses are further comprised of a filter structure	Claim 10 (original).
26	recesses are used as a microanalysis unit	Claim 11 (original).
28	work pieces are made of the same material	Specification, p. 7, lines 18-19.
29	PMMA, polycarbonate and polymethacryl	Specification, p. 5, lines 13-14.

No other amendments have been made, and no new matter has been added by the amendments. Reconsideration of the application is respectfully requested.

Claim Objections

The Examiner objected to claims 4 – 11 due to improper formation of multiple dependent claims. These deficiencies have been corrected by amendment. Accordingly, Applicants respectfully request the examination of these claims on their merits.

Rejections Under 35 U.S.C. 102

The Examiner rejected claims 1-3 under 35 U.S.C. 102 (b), as having been anticipated by Adachi et al., U.S. Patent 3,950,206. Applicants respectfully disagree with this rejection.

The Examiner states that Adachi et al. teaches the bonding of plastic pieces following high energy radiation of the contact surfaces in order to lower the glass transitional temperature, wherein the bonding occurs at a higher temperature than the glass transition temperature but lower than the untreated area. Applicants argue that the disclosure by Adachi et al. provides (a) an entirely different surface treatment process (corona discharge vs. high intensity radiation) in both physical process and result, (b) guidelines for temperature processing that teach away from Applicants' process, and (c) no motivation for applying their teaching towards the Applicants' goal of bonding plastic pieces while preserving the integrity of microstructures and/or nanostructures present within.

In the subject application, the method involves modifying a marginal layer of the contact surface in such a way that the glass transition temperature in this marginal layer is lowered. Continuing, "This is accomplished by radiating the contact surface with a high-energy radiation, such as UV, laser, X ray and/or synchrotron radiation." (Page 3, lines 2-4). In contrast, Adachi et al. rely upon a "corona discharge treatment" (Abstract; Column 1, lines 49-56; Column 3, line 59 –

column 4, line 8; etc.) in order to prepare the surface for bonding. In corona discharge, a strong electric field is used to ionize gases in the immediate vicinity, most typically oxygen, which when ionized produces ozone and other reactive oxygen species (refer to enclosure "Corona Discharge"). Thus a corona discharge treatment is the result of chemical reactions of highly reactive species and materially differs from the radiation processes claimed by the Applicants in method, mechanism and chemical outcome.

The temperature processing guidelines of Adachi et al. are made with reference only to the properties of the [bulk] film itself and make no account of any differences that may have been introduced by the corona treatment. The processing, described in Column 4, lines 39 – 48, calls for a bonding temperature "above the glass transition point of the polyester but below its melting point". The glass transition point refered to is that of the unmodified film piece itself. This disclosure teaches away from the Applicants' invention, which provides for a surface treatment by radiation such that bonding is effected at a temperature "...which is above the glass transition temperature of the marginal layer modified by radiation, but below that of the unmodified areas of the respective work piece" (Page 2, lines 25 – 27). Thus the operative temperatures taught in the respective disclosures are contradictory.

Lastly, the invention of Adachi et al. is directed towards bonding together polyester films or sheet-like structures to each other (Column 1, lines 2-3), without any disclosure or mention of microstructures, electrodes or fluidic elements within such films or sheet-like structures. Applicants assert that no motivation can be found for applying the methods of Adachi et al towards bonding pieces having microstructures, nanostructures, etc. because (a) there was no recognition of the desire to avoid "material flowing into and plugging such structures during the bonding process" (Page 3, line 27), and (b) the operative temperature processing guidelines contradict those of Applicants' invention, which require that "...the glass transition temperature of the unmodified work piece is not exceeded. They [the unmodified work piece section] retain their dimensional stability, and there is no danger that the recesses V are pinched or plugged during the bonding process." (Page 7, lines 14 – 17). Adachi et al. disclose bonding temperatures that are above the glass transition temperature of the film and thus introduce the certain risk that the film will not maintain its structural integrity if one were to incorporate microstructures into a film and practice their invention. This follows from the definition of the glass transition temperature, provided by the Encyclopedia of Polymer Science and Technology as the temperature at which "components are able to undergo large-scale molecular motions" (see enclosure "Glass Transition") . More

commonly stated, this is the point at which a polymer material begins to soften and flow. Applicants therefore assert that this disclosure does not anticipate the subject application.

In view of the above, Applicants respectfully request that this rejection be withdrawn.

For the above reasons, Applicants submit that any basis for objection or rejection of the pending claims has been overcome and respectfully request that it be withdrawn, and that the claims be allowed and the application quickly passed to issue.

If any additional time extensions are required, such time extensions are hereby requested. If any additional fees not submitted with this response are required, please take such fees from deposit account **50-2266**.

Respectfully submitted,

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Enclosures:

"Corona Discharge" (http://www.polytechconsultants.com/corona.htm)(with hardcopy attached as Exhibit A)

"Glass Transition" (http://www.mrw.interscience.wiley.com/epst/articles/pst149/abstract-fs.html); J. Bicerano in *Encyclopedia of Polymer Science and Technology*, J. Wiley & Sons, 2004. (Enclosed)

Supplemental Information Disclosure Statement with 1449 form.

Back to Blown Film Course

Corona Discharge

Low energy plastics, such as polypropylene (PP), polyethylene (PE) and Teflon (PTFE) are essentially "non-stick" plastics. Their molecular structure inhibits the adhesion and printing processes - this molecular structure is basically inert or inactive – these polymers are said to have a low surface energy. The surface energy or the wetability of a particular substrate is measured in dynes/cm (or ergs/cm^2, since 1 erg = 1 dyne cm) and, when tested, untreated PP and PE will have a low surface energy (usually 30 to 32 dynes/cm). The most common method of determining the surface energy is to measure the contact angle of a water droplet on the substrate surface. The contact angle between the solid and the fluid is the angle measured within the fluid, between the solid surface and the tangent plane to the liquid surface at the point of intersection (see Figure 1 below). A contact angle of greater than 90° indicates that the fluid (which is ink or adhesive in this case) has not wet the surface. Conversely an angle of less than 90° means that the fluid has wet the surface - if the angle approaches zero then the surface is completely wetted by the fluid.

Use of a corona, flame or other surface treatment will raise the surface energy level to values in excess of 42 dynes/cm. Ideally, the surface energy of the plastic should be 7 to 10 dynes/cm higher than the surface tension of the solvent or liquid. For example, a printing ink having a surface tension of 30 dynes/cm would not adequately wet or bond to a material having a surface energy less than 37 to 40 dynes/cm.

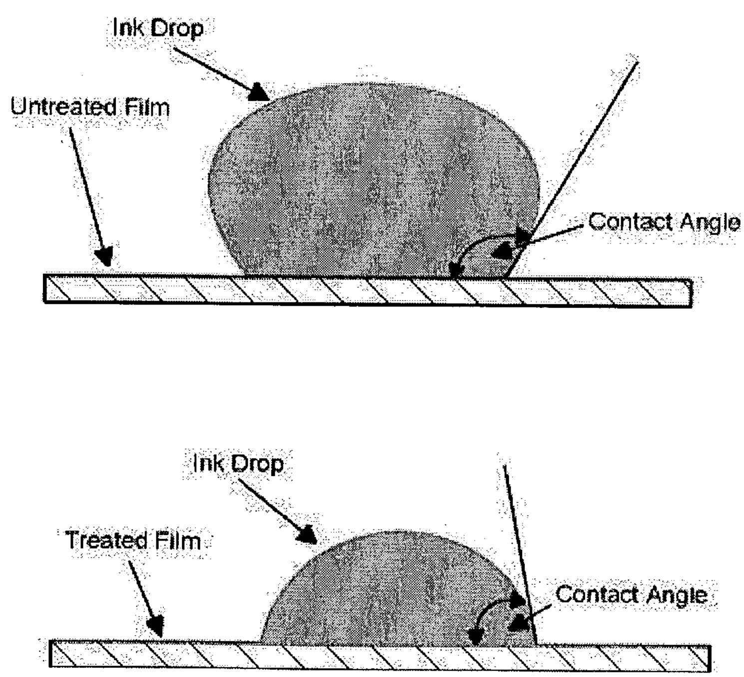

Figure 1 Schematic Representation of Surface Tension

Corona Discharge treatment is the most common method of increasing the energy level of PP and PE materials (see below). This process uses an electric current to create an ozone

generating spark - a corona. The ozone within the corona reacts with the PP or PE surface to raise the energy level. While this method is very popular, it is not long lasting and the increase in the surface energy can disappear within weeks.

A corona treatment system in its simplest form can be thought of as a capacitor. Voltage is applied to the top plate which, in the case of corona treatment, would be the electrode (see Figure 2 below). The dielectric portion of the capacitor would be made up of some type of roll covering, air and the substrate (film or sheet). The final component, or bottom plate, would take the form of an electrically grounded roll. In the corona treatment system the voltage build-up ionises the air in the air gap creating a corona, which modifies the surface and increases the surface energy of the substrate passing over the electrically grounded roll. The level of treatment is controlled by the energy of the discharge and the air gap. For health and safety reasons, the ozone generated in the corona must be removed from the working environment.

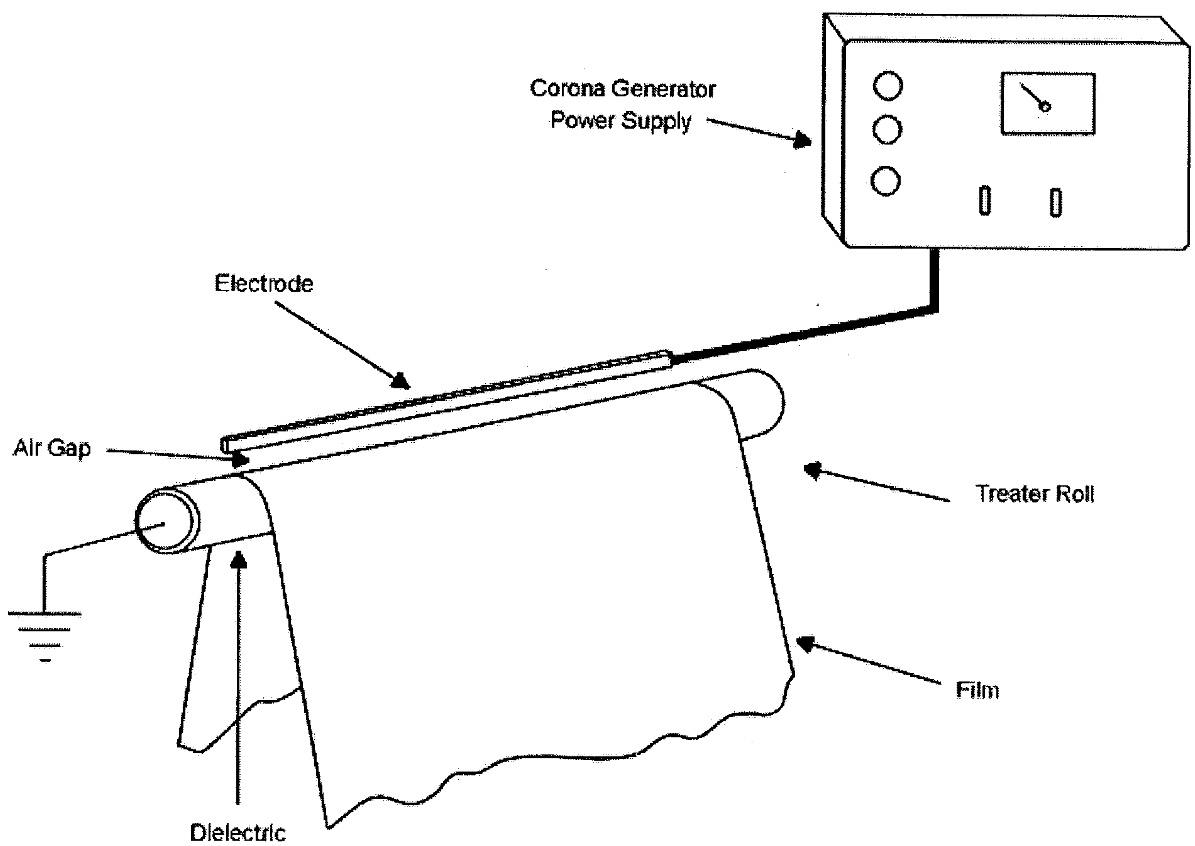

Figure 2 Corona Treatment System

The corona treatment system is introduced into the film blowing equipment usually at the top of the tower (see Figure 3 below), but not always. Some systems incorporate the treatment midway up the tower or at the base.

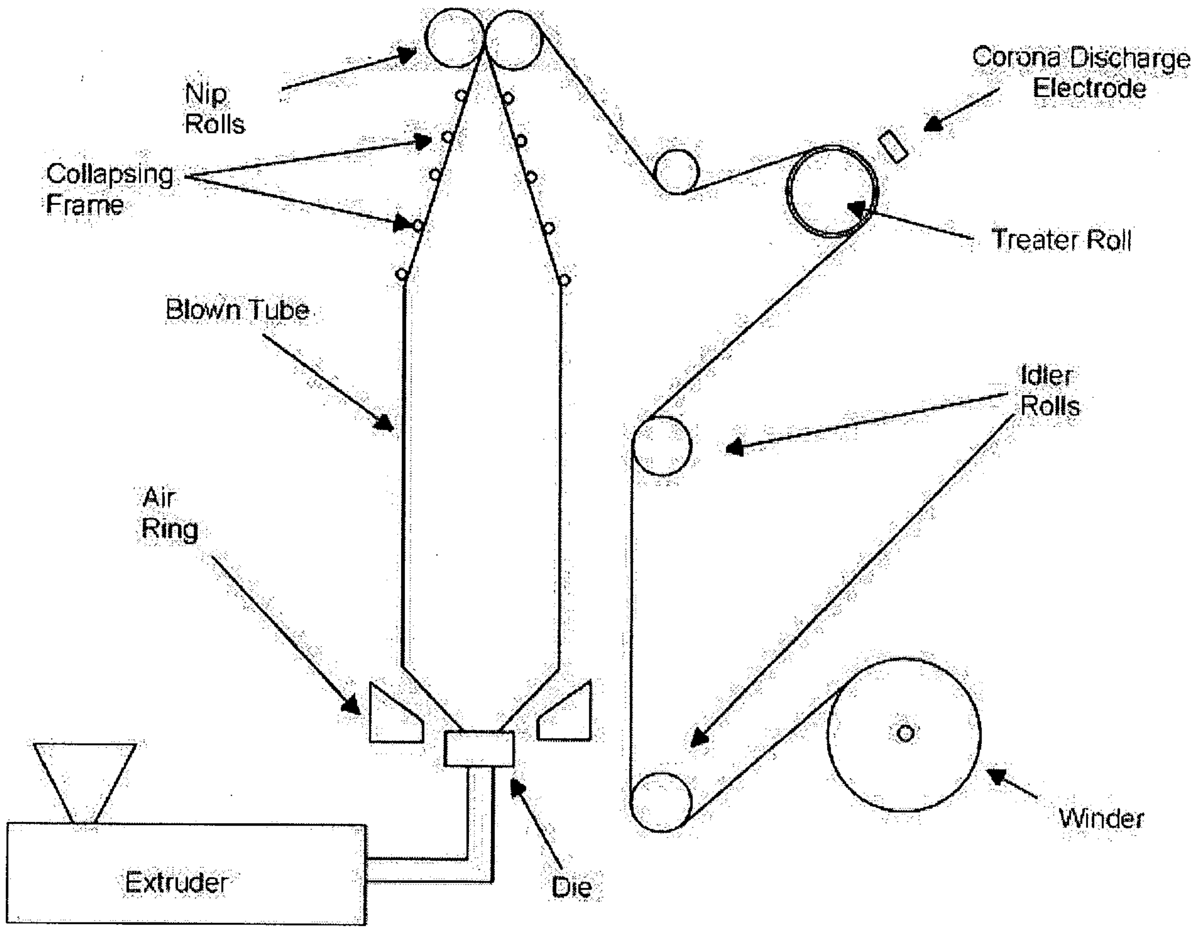

Figure 3 Line Schematic – Top of the Tower Treatment

Similarly, the corona treatment system would be included in the line of an extruded sheet line (see Figure 4) and stentered film .

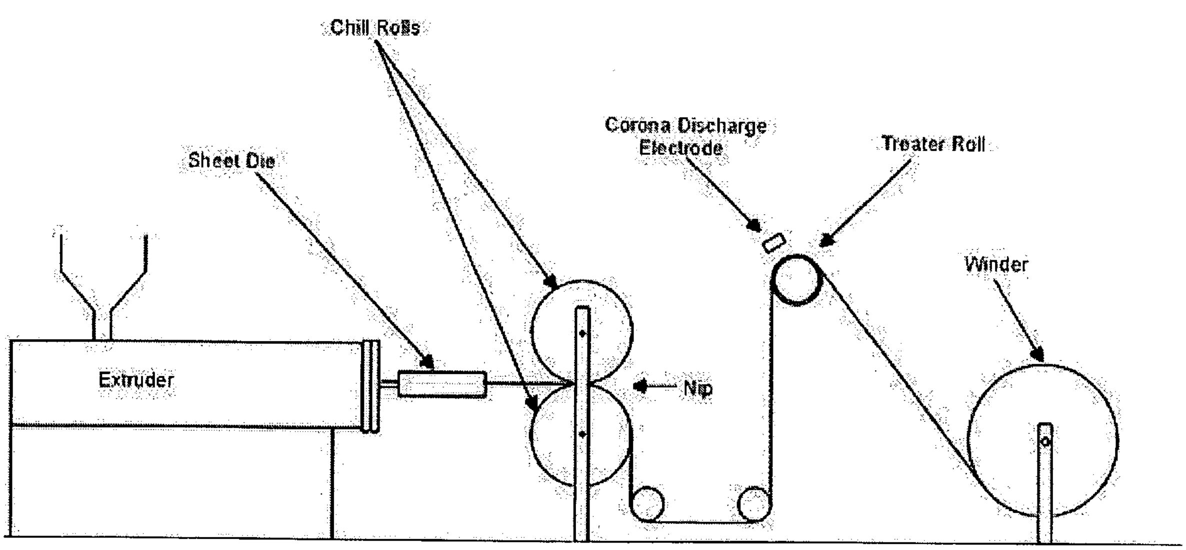

Figure 4 Sheet Extrusion Line

Flame treatment is also a common method of increasing the energy level of PP and PE materials. This process uses an oxygenated flame to create free oxygen. This free oxygen then reacts with the surface of the PP or PE and raises the surface energy level. As with corona treatment, this method is not long lasting and can disappear within weeks.

Problems you might find

Backside Treatment of the web occurs when the corona (oxidised air) is present at the surface of the material. So, if the wrap is insufficient on the treater roll (see Figure 5 below), backside treatment (treatment on both sides of the web) will occur. Solutions to backside treatment range from ensuring that there is more wrap on the roll to the use of nip rolls.

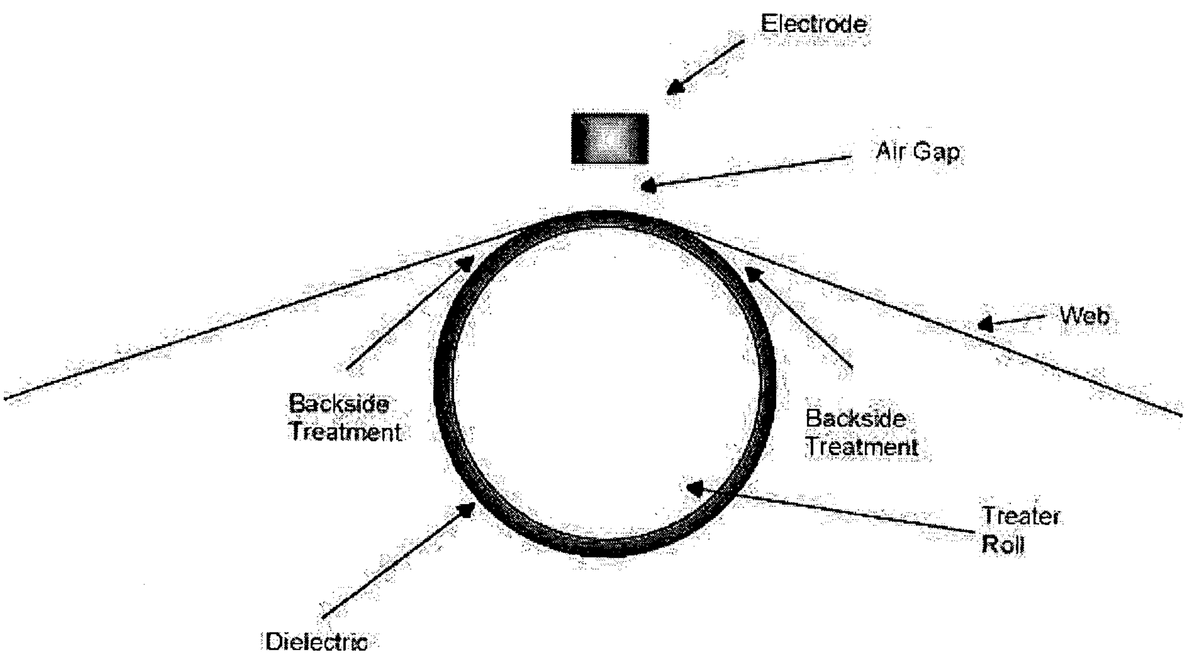

Figure 5 Insufficient Wrap leads to Backside Treatment

Blocking. The greater the level of treatment, the higher the degree of oxidation of the surface. The polar groups formed by the corona have an attraction for the molecular layer on the other side of the web, and when the two sides come into contact when they are on the roll, a self-adhering condition exists. Sometimes this attraction can be greater than the internal bonds of the substrate so that delamination of the substrate can occur when the product is unrolled. The tighter the roll is wound and the longer it is in storage the more severe the problem becomes. Blocking is worse in the film at the centre of the roll.

Heat Sealing. Excessive treatment also leads to problems when attempting to heat seal the product.

Additives. If the polypropylene or polyethylene contain additional components, such as slip additives or some processing aids, the initial treatment is reduced over time as these additives bloom (migrate) to the surface and partially mask the polar groups formed during treatment. For this reason, it is better to treat these films at the point of use rather than the point of manufacture.

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